

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
1 February 2001 (01.02.2001)

PCT

(10) International Publication Number
WO 01/08425 A2

(51) International Patent Classification⁷: H04Q 3/00

(21) International Application Number: PCT/SE00/01516

(22) International Filing Date: 25 July 2000 (25.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/362,779 28 July 1999 (28.07.1999) US

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— Without international search report and to be republished upon receipt of that report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SYSTEM AND METHOD FOR PROVIDING GEOGRAPHICAL INFORMATION IN A NON-GEOGRAPHIC NETWORK

(57) Abstract: A telecommunications system and method is disclosed for providing to a calling subscriber (100) geographical information associated with the location of a called subscriber (150) prior to connection of a call. When the calling subscriber dials the directory number (105) associated with a called subscriber that has been ported or that has a non-geographic number, the originating switch performs a query to a database (130) to retrieve a routing number for the called subscriber. This routing number is used by the originating switch to produce and transmit called party location (CPL) information to the calling subscriber prior to connecting the call. The CPL information can be provided to the calling subscriber as an announcement or as a text-based message. This CPL information allows the calling subscriber to estimate the cost of the call (long-distance versus local) and the convenience of the call prior to connection of the call.



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SYSTEM AND METHOD FOR PROVIDING GEOGRAPHICAL INFORMATION IN A NON-GEOGRAPHIC NETWORK

BACKGROUND OF THE PRESENT INVENTION

Field of the Invention

The present invention relates generally to telecommunications systems and methods for providing number portability to subscribers, and specifically to connecting
5 calls to subscribers having a ported or portable number.

Background and Objects of the Present Invention

Currently, fixed (wireline) telephone subscribers are assigned a geographic directory number that contains enough information to determine how to route a call
10 to the subscriber associated with that directory number. Likewise, cellular subscribers also are assigned a geographic directory number or a directory number that identifies the network provider.

With the advent of number portability (NP), the directory number assigned to a subscriber may not provide adequate location information for routing calls to that
15 subscriber. NP allows subscribers to change network provider operators while retaining the same directory number, and is currently being provided in certain parts of the world as a local service. The existing local number portability (LNP) feature only allows a subscriber to change operators within the same area code. However, it is foreseen that NP will be expanded to allow a subscriber to retain the same directory
20 number regardless of the geographical location of the subscriber.

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In addition, for next-generation wireless-access services, such as the Personal Communications Service (PCS) system, subscribers will be assigned non-geographic numbers (NGN), which do not contain any information specifying the geographic region or network provider serving that called subscriber. NGN's will ultimately allow
5 subscribers to receive calls at any terminal, either fixed or wireless, regardless of which service provider is used.

In either case, the network must be able to associate the dialed directory number with a specific destination terminal, so that incoming calls can be routed to that destination terminal. Typically, the destination terminal can be identified by
10 performing a query to a database containing a list of dialable directory numbers and associated routing numbers. For example, in an Advanced Intelligent Network (AIN) environment, the database can be accessed through a Service Control Point (SCP) queried by a Service Switching Point (SSP), which could be the originating switch, a tandem (intermediate) switch or the destination switch for the dialed directory number.

15 However, with the introduction of full number portability comes charging problems. Today, the calling subscriber assumes all local and long-distance charges for a call to the called subscriber. The calling subscriber relies upon the dialed directory number to estimate the charges (local versus long-distance) for the call. In addition, the dialed directory number also provides information on the convenience
20 of the call, since the dialed directory number typically informs the calling subscriber about the relative time zone difference between the subscribers.

With the implementation of full NP, the called subscriber could be located anywhere in the world, even though the dialed directory number may be perceived as a local number to the calling subscriber. Therefore, the calling subscriber may be

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charged for a long-distance call without realizing that the call is a long-distance call. Thus, the dialed directory number will no longer provide adequate information to calling subscribers concerning the cost of the call or the convenience of the call.

It is, therefore, an object of the present invention to provide geographical
5 information associated with the called subscriber to the calling subscriber prior to connection of the call.

SUMMARY OF THE INVENTION

The present invention is directed to telecommunications systems and methods
10 for providing to the calling subscriber geographical information associated with the location of the called subscriber prior to connection of the call. When the calling subscriber dials the directory number associated with a called subscriber that has been ported or that has a non-geographic number, the originating switch (or a tandem or destination switch associated with the dialed directory number) performs a query to
15 a database to retrieve a routing number for a current destination switch for the called subscriber. This routing number is passed back to the originating switch, which uses this routing number to produce and transmit called party location (CPL) information to the calling subscriber prior to connecting the call. The CPL information can be provided to the calling subscriber as an announcement message. This CPL
20 information allows the calling subscriber to estimate the cost of the call (long-distance versus local) and the convenience of the call. If the calling subscriber does not wish to incur the charges or inconvenience the called subscriber, the calling subscriber can simply "hang up" to prevent the call from being connected. Alternatively, the

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originating switch can prompt the calling subscriber to either accept or reject the call based upon the CPL information.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The disclosed invention will be described with reference to the accompanying drawings, which show important sample embodiments of the invention and which are incorporated in the specification hereof by reference, wherein:

FIGURES 1A and 1B are block diagrams illustrating the conventional routing of a call to a ported terminal (wireline or wireless);

10 FIGURE 2 is a block diagram illustrating the providing of an announcement to the calling subscriber regarding the geographical location of the called subscriber when the called subscriber has ported from one service area to a new service area in accordance with embodiments of the present invention;

15 FIGURE 3 is a signaling diagram illustrating the signaling involved in providing the announcement shown in FIGURE 2 of the drawings;

20 FIGURE 4 is a block diagram illustrating the providing of an announcement to the calling subscriber regarding the geographical location of the called mobile station when the called mobile station has ported from one home location register to a new home location register in accordance with embodiments of the present invention;

FIGURE 5 is a signaling diagram illustrating the signaling involved in providing the announcement shown in FIGURE 4 of the drawings;

FIGURE 6 is a block diagram illustrating the providing of an announcement to the calling subscriber regarding the geographical location of the called subscriber

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when the called subscriber has a non-geographic directory number in accordance with embodiments of the present invention; and

FIGURE 7 is a signaling diagram illustrating the signaling involved in providing the announcement shown in FIGURE 6 of the drawings.

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DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

The numerous innovative teachings of the present application will be described with particular reference to the presently preferred exemplary embodiments. However,
10 it should be understood that this class of embodiments provides only a few examples of the many advantageous uses of the innovative teachings herein. In general, statements made in the specification of the present application do not necessarily delimit any of the various claimed inventions. Moreover, some statements may apply to some inventive features but not to others.

15 With reference now to FIGURE 1A of the drawings, the concept of number portability (NP) allows a subscriber 150 to relocate or "port" from a first service area 160a to a second service area 160b or from a first network operator to a second network operator, the former being illustrated, without changing the directory number 105 associated with that subscriber 150. By not changing the assigned directory
20 number 105, the subscriber 150 need not inconveniently notify his friends and associates of his new number when the subscriber 150 moves to a new service area 160b or changes network operators.

NP also allows more efficient usage and better management of network resources. If a service area includes a number of switches, and the work load or

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capacity is unevenly distributed across the switches in the service area, it would be advantageous to transfer some of the subscriptions from an overloaded switch to another switch with lesser load without changing the directory numbers assigned to the associated subscriptions.

5 As shown in FIGURE 1A, in order to implement NP not only locally, but also nationally and internationally, a database 130 must house routing information to route calls to ported directory numbers 150. For example, when a calling subscriber 100 dials a directory number 105 associated with a called subscriber 150 that has been ported from a first switch or Service Switching Point (SSP) 140a within a first service
10 area 160a to a second SSP 140b within a second service area 160b, an originating SSP 110 serving the calling subscriber 100 can perform a query 115 to a Service Control Point (SCP) 120 to determine routing information for the call. In response to the query 115, the SCP 120 accesses a NP database 130 to retrieve a Location Routing Number (LRN) 125, which is a number used to identify the switch 140b to which that called
15 subscriber 150 has been ported. The LRN 125 can be retrieved by the database 130 performing a look-up on the dialed directory number 105 and cross-correlating this dialed directory number 105 with the appropriate LRN 125. It should be noted that in an architecture not capable of supporting the Advanced Intelligent Network (AIN), the query 115 could be a Transactions Capabilities Application Part (TCAP) query directly
20 to the database 130.

Upon receipt of the LRN 125, the originating SSP 110 places the LRN 125 in a Called Party Number (CPN) parameter 175 within an Initial Address Message (IAM) 170, and routes the call to the destination SSP 140b currently serving the called subscriber 150. Thereafter, the destination SSP 140b connects the call to the called

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subscriber 150. It should be noted that if the originating SSP 110 is not AIN-capable, a tandem (intermediate) SSP (not shown) or the SSP 140a that the called subscriber 150 ported from may perform the query 115. If the ported-from SSP 140a performs the query 115, the ported-from SSP 140a can either forward the IAM 170 with the
5 LRN 125 to the ported-to SSP 140b or can send the LRN 125 back to the originating SSP 110 or a tandem SSP to re-transmit the IAM 170 with the LRN 125 to the ported-to SSP 140b.

If, as shown in FIGURE 1B of the drawings, the called subscriber 150 is a mobile subscriber that has been ported from a first home location register (HLR) 30a
10 associated with a first Gateway Mobile Switching Center (GMSC) 50a to a second HLR 30b associated with a second GMSC 50b, the LRN 125 provided by the SCP 120 is a network address for the second GMSC 50b associated with the second HLR 30b currently serving the called mobile subscriber 150.

The LRN 125 can be used by the originating SSP 110 to route the call to the
15 second GMSC 50b to perform a query the ported-to HLR 30b for a roaming number (called a Mobile Station Roaming Number (MSRN) 128) for a Mobile Station (MS) 155 associated with the called mobile subscriber 150. Alternatively, as is shown in FIGURE 1B, if the first GMSC 50a performs the query to the SCP 120, the LRN 125 can be passed back to the first GMSC 50a to route the call to the second GMSC 50b
20 to perform the query 115 to the ported-to HLR 30b. In either case, the MSRN 128, which is a temporary directory number used to route the call to a Mobile Switching Center (MSC) 40 currently serving the MS 155, is passed back to the second GMSC 50b by the ported-to HLR 30b, and placed by the second GMSC 50b in the CPN parameter 175 of the IAM 170 in order to route the call from the GMSC 50b to the

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serving MSC 40. Once the serving MSC 40 receives the IAM 170, the serving MSC 40 can page the MS 155 and establish a call connection with the MS 155 over an air interface 70.

If the called subscriber 150 has ported to a new service area within a different Local Access Transport Area (LATA), the area code associated with the called subscriber 150 may have changed, even though the dialed directory number 105 has not changed. In these situations, the calling subscriber 100 may not have knowledge of the long-distance leg required to establish a call connection with the called subscriber 150. Since the calling subscriber 100 is typically responsible for paying for the long-distance leg of the call, knowledge of the geographical location of the SSP 140 or MSC 40 currently serving the called subscriber will enable the calling subscriber 100 to estimate charges for the call. In addition, such geographical information may allow the calling subscriber 100 to make judgments concerning the convenience of the call.

Therefore, with reference now to FIGURE 2 of the drawings, geographical information, hereinafter termed Called Party Location (CPL) information 180, regarding the location of the called subscriber 150 can be provided to the calling subscriber 100 prior to allowing the call to proceed to completion. For example, the CPL information 180 could be an area code associated with the current location of the called subscriber 150. Alternatively, and preferably, the CPL information 180 could include a city, state and country where the called subscriber 150 is located. In addition to the city and state information, the CPL information 180 could also include the current local time within the city where the called subscriber 150 is located. This CPL

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information 180 will allow the calling subscriber 100 to estimate the cost of the call (long-distance versus local) and the convenience of the call.

The signaling involved in providing this CPL information 180 will now be discussed in connection with FIGURE 2 and the signaling diagram shown in FIGURE 3 of the drawings. When a calling subscriber 100 dials the directory number 105 of a called subscriber 150 that has been ported from a first SSP 140a to a second SSP 140b (step 300), the originating SSP 110 serving the calling subscriber 100 can either query 115 the SCP 120 directly, or, if the originating SSP 110 is not AIN-capable, forward the IAM 170 with the dialed directory number 105 as the CPN parameter 175 to a tandem SSP or to the SSP 140a that the called subscriber 150 ported from (step 310), the latter being illustrated. If the ported-from SSP 140a receives the call to the called subscriber 150, as is shown, the ported-from SSP 140a will realize that the called subscriber 150 has been ported from the SSP 140a, and perform the query 115 to the SCP 120 (step 320).

In response to the query 115, the SCP 120 accesses the NP database 130 (step 330) to retrieve the LRN 125 associated with the ported-to SSP 140b (step 340), and returns this LRN 125 to the ported-from SSP 140a (step 350). Thereafter, the ported-from SSP 140a can return the LRN 125 to the originating SSP 110 (step 360) to connect the call. To prevent the ported-from SSP 140a from connecting the call directly to the ported-to SSP 140b, an indication 165 can be included within the IAM 170 or sent separately, the latter being illustrated, to return the LRN 125, if different from the dialed directory number 105, to the originating SSP 110. Upon receipt of the LRN 125, the originating SSP 110 utilizes the LRN 125 to determine the CPL information 180 (step 370). As discussed above, the CPL information 180 can

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include, for example, an area code or country code associated with the location of the called subscriber 150, the geographical location of the called subscriber 150 or the current time in the geographical location of the called subscriber 150.

For example, the first three-digits in the LRN 125 typically correspond to an
5 area code or country code associated with the location of the called subscriber 150. Based upon this area code or country code, the originating SSP 110 can access a database 185 or table within the SSP 110 to cross-correlate the area code or country code part of the LRN 125 with geographical location information 180, such as the city, state and/or country, associated with that area code or country code. In addition to
10 determining the geographical location information 180, the database 185 may also provide time information 180 associated with the current time within the geographical location of the called subscriber 150.

Once the CPL information 180 is determined, the originating SSP 110 sends a message 195 to the calling subscriber 100 including the CPL information 180 (step
15 380). For example, the originating SSP 110 can access an announcement machine 190 therein, and instruct the announcement machine 190 to play an announcement 195 containing the CPL information 180 to the calling subscriber 100. For example, the announcement 195 could say: "The party you are calling is now located in Denver, Colorado. The current time in Denver is 12:00 p.m." After delivery of this message
20 195, to complete the call (step 390), the originating SSP 110 can place the LRN 125 in the CPN parameter 175 of the IAM 170 and transmit the IAM 170 to the ported-to SSP 140b (step 395) to connect the call to the called subscriber 150 (step 398). If the calling subscriber 100 does not wish to complete the call, the calling subscriber 100 can simply "hang up" before or during the ringing of the call. As long as the calling

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subscriber 100 disconnects the call before the called subscriber 150 answers, the calling subscriber 100 will not incur any charges for the call.

In an alternative embodiment, in addition to including the CPL information 180 in the announcement 195, the announcement 195 can also contain a prompt for the calling subscriber to enter a response, such as "To continue the call, press or say 1. To disconnect, hang up." If the originating SSP 110 does not receive the response (step 390), such as a DTMF signal corresponding to depressing the number "one" on the telephone, from the calling subscriber 100, the originating SSP 110 does not setup the call (steps 395 and 398). Preferably, simultaneous to sending the announcement 195, the originating SSP 110 initiates a timer 112 therein. If a response (step 390) is not received before the expiration of the timer 112 (either a "one" or a disconnect), the originating SSP 110 continues to setup the call. This would be beneficial to calling subscribers 100 using rotary phones, where voice responses are not able to be received by the originating SSP 110.

With reference now to FIGURE 4 of the drawings, which will be described in connection with the signaling diagram shown in FIGURE 5 of the drawings, if the called subscriber 150 is a mobile subscriber that has an MS 155 associated therewith, when the originating SSP 110 receives the dialed directory number 105 (step 500), the originating SSP 110 can either directly query 115 the SCP 120, or alternatively, as shown, route the IAM 170 with the dialed directory number 105 as the CPN parameter 175 to, for example, a ported-from GMSC 50a (step 505) to perform the query 115 (step 510). Since the called subscriber 150 is also a mobile subscriber with an associated MS 155, the LRN 125 retrieved from the database 130 by the SCP 120 (steps 515 and 520) will be a network address for a ported-to GMSC 50b associated

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with the ported-to HLR 30b. Thereafter, the SCP 120 returns the LRN 125 to the ported-from GMSC 50a (step 525), which in turn returns the LRN 125 to the originating SSP 110 (step 530). The indication 165 may need to be sent to the ported-from GMSC 50a to ensure that the LRN 125 is returned to the originating SSP 110.

5 The originating SSP 110 uses the LRN 125 to determine the CPL 180 information (step 535), as discussed hereinbefore.

Once the CPL information 180 is determined (step 535), the originating SSP 110 can access the announcement machine 190 and transmit the announcement 195 containing the CPL information 180 to the calling subscriber 100 prior to connecting

10 the call (step 540). If the calling subscriber 100 wants to continue with the call (step 545), the originating SSP 110 can send the IAM 170 with the LRN 125 in the CPN parameter 175 to the ported-to GMSC 50b (step 550). Thereafter, the ported-to GMSC 50b queries 115 the ported-to HLR 30b (step 555) for a MSRN 128 for the called MS 155 (step 560), and routes the call to the serving MSC 40 (step 565) to

15 establish a call connection with called MS 155 (step 570).

Alternatively, the MSRN 128, instead of the LRN 125 can be sent back to the originating SSP 110 from the ported-to GMSC 50b if the ported-from GMSC 50a does not send back the LRN 125, and instead, routes the call to the ported-to GMSC 50b. In this case, the MSRN 128 would be used to determine the CPL information 180, and

20 would be populated in the CPN parameter 175 of the IAM 170 to the serving MSC 40.

With reference now to FIGURE 6 of the drawings, which will be described in connection with the signaling diagram shown in FIGURE 7 of the drawings, if the called subscriber 150 has a non-geographic number (NGN) 105, such that the destination terminal associated with the called subscriber 150 can change depending

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on where the subscriber 150 is currently registered, a database query 115 must also be performed to connect calls to the called subscriber 150. With NGNs 105, the subscriber 150 associated with the NGN 105 can register on any terminal, fixed or wireless, and have calls delivered to that registered terminal as long as the subscriber
5 150 is authenticated and the network associated with that terminal grants permission for use. Once registered, the LRN 125 associated with the current destination terminal for the NGN 105 is stored in an NGN database 130.

When the calling subscriber 100 dials the NGN 105 associated with the called subscriber 150 (step 700), the originating SSP 110 can either directly query the SCP
10 120, or, as is shown, transmit the IAM 170 with the NGN 105 as the CPN parameter 175 to a Signaling Transfer Point (STP) 80 (step 710) to perform the query 115 (step 720). STPs 80 serve as a router for switching messages between SSPs 110 and 140 or for forwarding messages to an SCP 120. If the STP 80 performs the query 115, the indication 165 to pass back the LRN 125 to the originating SSP 110 is also sent with
15 the IAM 170.

Once the STP 80 receives the LRN 125 associated with the network address for the current SSP 140 or HLR (not shown) serving the called subscriber 150 (steps 730-750), the STP 80 transmits this LRN 125 back to the originating SSP 110 (step 760). Once the LRN 125 is received, the originating SSP 110 utilizes this LRN 125
20 to determine the CPL information 180 (step 770). Thereafter, the originating SSP 110 transmits an announcement including the CPL information 180 to the calling subscriber 100 (step 780). If the calling subscriber 100 chooses to continue with the call based upon the CPL information 180 (step 790), the originating SSP 110 uses the LRN 125 as the CPN parameter 175 within the IAM 170 to transmit the IAM 170 to

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the destination SSP 140 via the STP 80 (step 795) or MSC in order to connect the call to the called subscriber 150 (step 798).

As will be recognized by those skilled in the art, the innovative concepts described in the present application can be modified and varied over a wide range of applications. Accordingly, the scope of patented subject matter should not be limited to any of the specific exemplary teachings discussed, but is instead defined by the following claims.

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WHAT IS CLAIMED IS:

1. A telecommunications system for providing a message to a calling subscriber, said message containing called party location information associated with a called subscriber, comprising:

5 an originating switch serving said calling subscriber for receiving a dialed directory number associated with said called subscriber from said calling subscriber, determining said called party location information associated with said called subscriber and transmitting said message including said called party location information to said calling subscriber; and

10 a database for storing said dialed directory number and an associated location routing number, receiving a query including said dialed directory number from said originating switch, correlating said dialed directory number with said associated location routing number and transmitting said associated location routing number back to said originating switch;

15 wherein said originating switch uses said location routing number to determine said called party location information.

2. The telecommunications system of Claim 1, wherein said message is an announcement.

20

3. The telecommunications system of Claim 2, wherein said originating switch further comprises an announcement machine for playing said announcement to said calling subscriber.

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4. The telecommunications system of Claim 1, wherein said originating switch is a Service Switching Point.

5. The telecommunications system of Claim 1, wherein said location routing number is a network address for a Service Switching Point serving said called subscriber.

6. The telecommunications system of Claim 5, wherein said called subscriber was ported to said Service Switching Point from a previous Service Switching Point.

7. The telecommunications system of Claim 1, wherein said location routing number is a network address for a gateway mobile switching center associated with said called subscriber.

15

8. The telecommunications system of Claim 7, wherein said gateway mobile switching center queries a home location register associated with said called subscriber to determine a roaming number for said called subscriber, said roaming number being used to route a call to said called subscriber.

20

9. The telecommunications system of Claim 8, wherein said roaming number is used to determine said called party location information.

10. The telecommunications system of Claim 8, wherein said roaming

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number is a temporary directory number used for routing calls to a Mobile Switching Center in wireless communication with a Mobile Station associated with said called mobile subscriber.

5 11. The telecommunications system of Claim 8, wherein said called subscriber was ported to said home location register from a previous home location register.

10 12. The telecommunications system of Claim 1, wherein said dialed directory number is a non-geographic number.

15 13. The telecommunications system of Claim 1, further comprising:
a service control point in communication with said database for receiving said query and transmitting said location routing number to said originating switch.

14. The telecommunications system of Claim 1, further comprising:
an additional switch for receiving a message including said dialed directory number from said originating switch, performing said query to said database and transmitting said location routing number back to said originating switch.

20 15. The telecommunications system of Claim 1, wherein said called party location information comprises geographical location information associated with said called subscriber.

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16. The telecommunications system of Claim 17, wherein said called party location information further comprises time information associated with said geographical location information.

5 17. A method for providing a message to a calling subscriber, said message containing called party location information associated with a called subscriber, comprising the steps of:

receiving at an originating switch serving said calling subscriber a call and an associated dialed directory number associated with said called subscriber from said
10 calling subscriber;

performing a query including said dialed directory number to a database;

correlating said dialed directory number with an associated location routing number stored within said database;

transmitting said associated location routing number back to said originating
15 switch;

determining said called party location information associated with said called subscriber using said associated location routing number; and

transmitting said message including said called party location information to said calling subscriber.

20

18. The method of Claim 17, wherein said step of transmitting said message further comprises the steps of:

accessing an announcement machine within said originating switch; and

playing an announcement including said called party location information, by

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said announcement machine, to said calling subscriber.

19. The method of Claim 17, wherein said step of correlating further comprises the step of:

5 correlating said dialed directory number associated with a first Serving Switching Point that said called subscriber was ported from with said location routing number associated with a second Service Switching Point that said called subscriber was ported to.

10 20. The method of Claim 17, wherein said step of correlating further comprises the step of:

correlating said dialed directory number associated with a first home location register that said called subscriber was ported from with said location routing number associated with a second home location register that said called subscriber was ported
15 to.

21. The method of Claim 17, wherein said step of determining said called party location information further comprises the steps of:

routing said call from said originating switch to a gateway mobile switching
20 center associated with a home location register serving said called subscriber using said location routing number;

querying, by said gateway mobile switching center, said home location register to determine a roaming number for said called subscriber; and

determining said called party location information using said roaming number.

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22. The method of Claim 17, wherein said dialed directory number is a non-geographic number.

23. The method of Claim 17, wherein said step of performing said query
5 further comprises the steps of:

receiving, at a service control point in communication with said database, said query; and

accessing said database, by said service control point to determine said associated location routing number.

10

24. The method of Claim 17, wherein said step of performing said query further comprises the steps of:

receiving, at an additional switch, a message including said dialed directory number from said originating switch; and

15 performing, by said additional switch, said query to said database.

25. The method of Claim 17, further comprising the steps of:

determining, by said calling subscriber, whether to continue with said call to said called subscriber based on said calling party location information; and

20 if so, connecting said call from said originating switch to said called subscriber using said location routing information.

26. The method of Claim 25, wherein said step of determining whether to continue said call further comprises the steps of:

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providing a prompt to continue with said call to said calling subscriber; and
accepting a response to continue said call by said originating switch, said step
of connecting being performed when said originating switch receives said response.

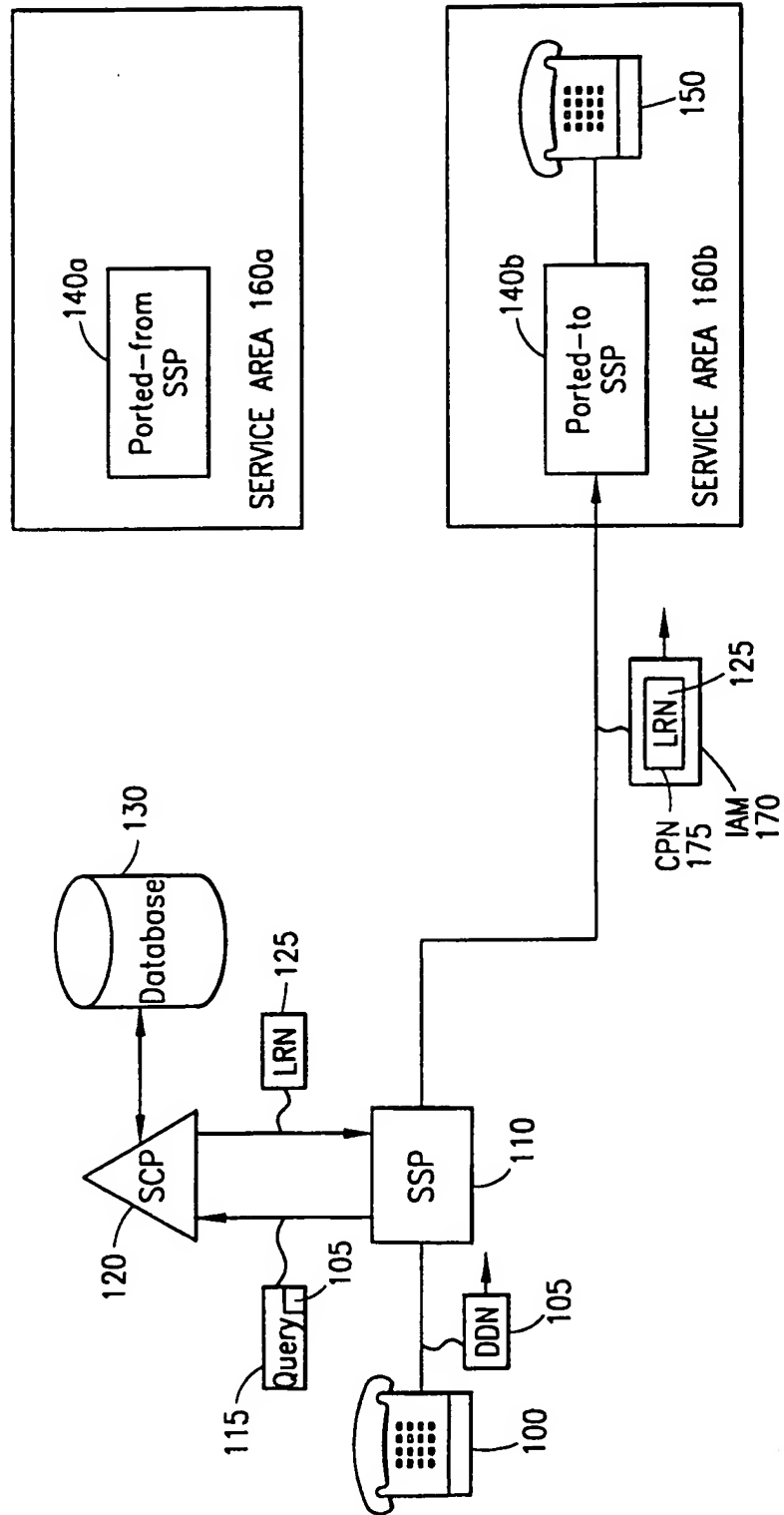


FIG. 1A

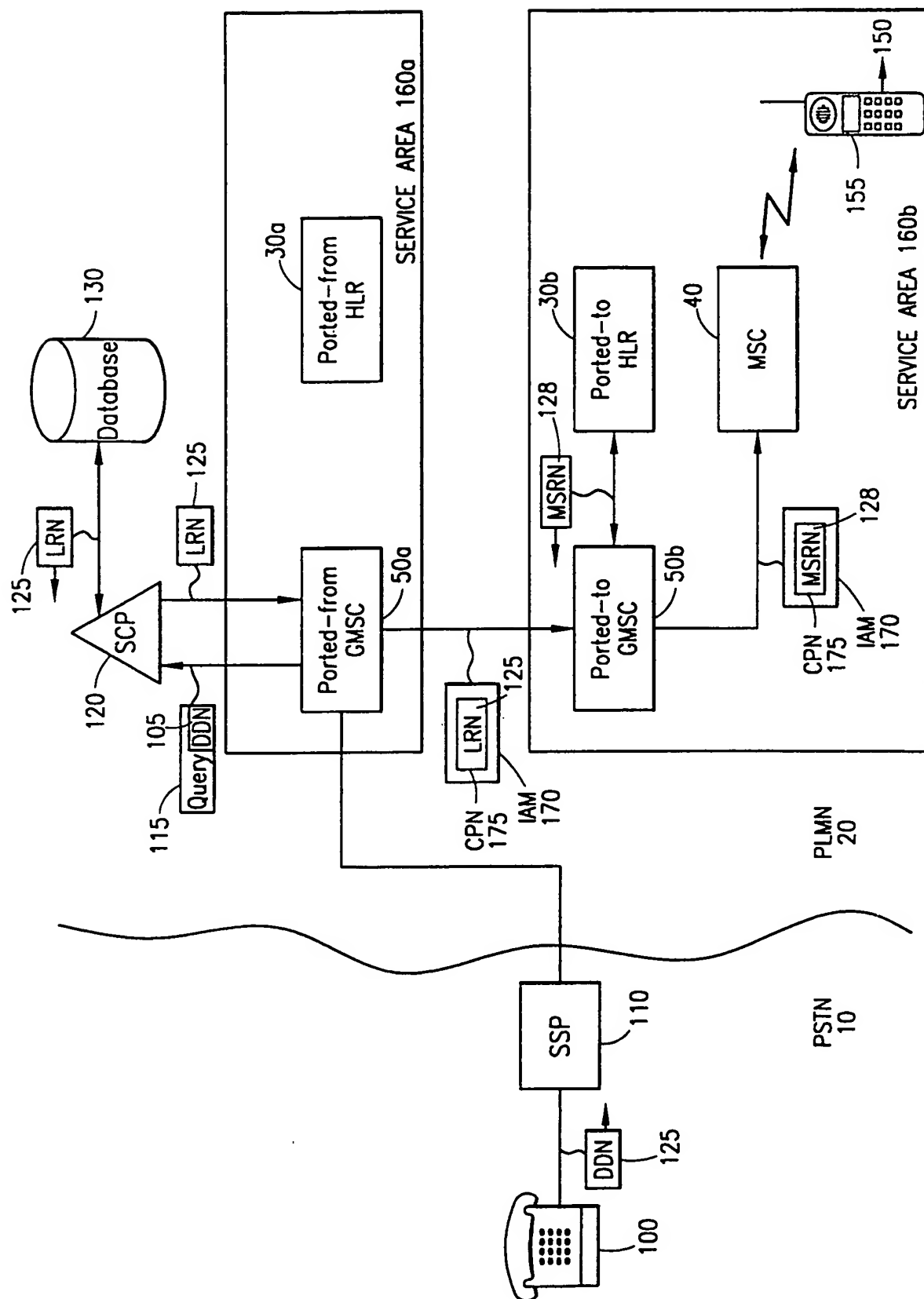


FIG. 1B

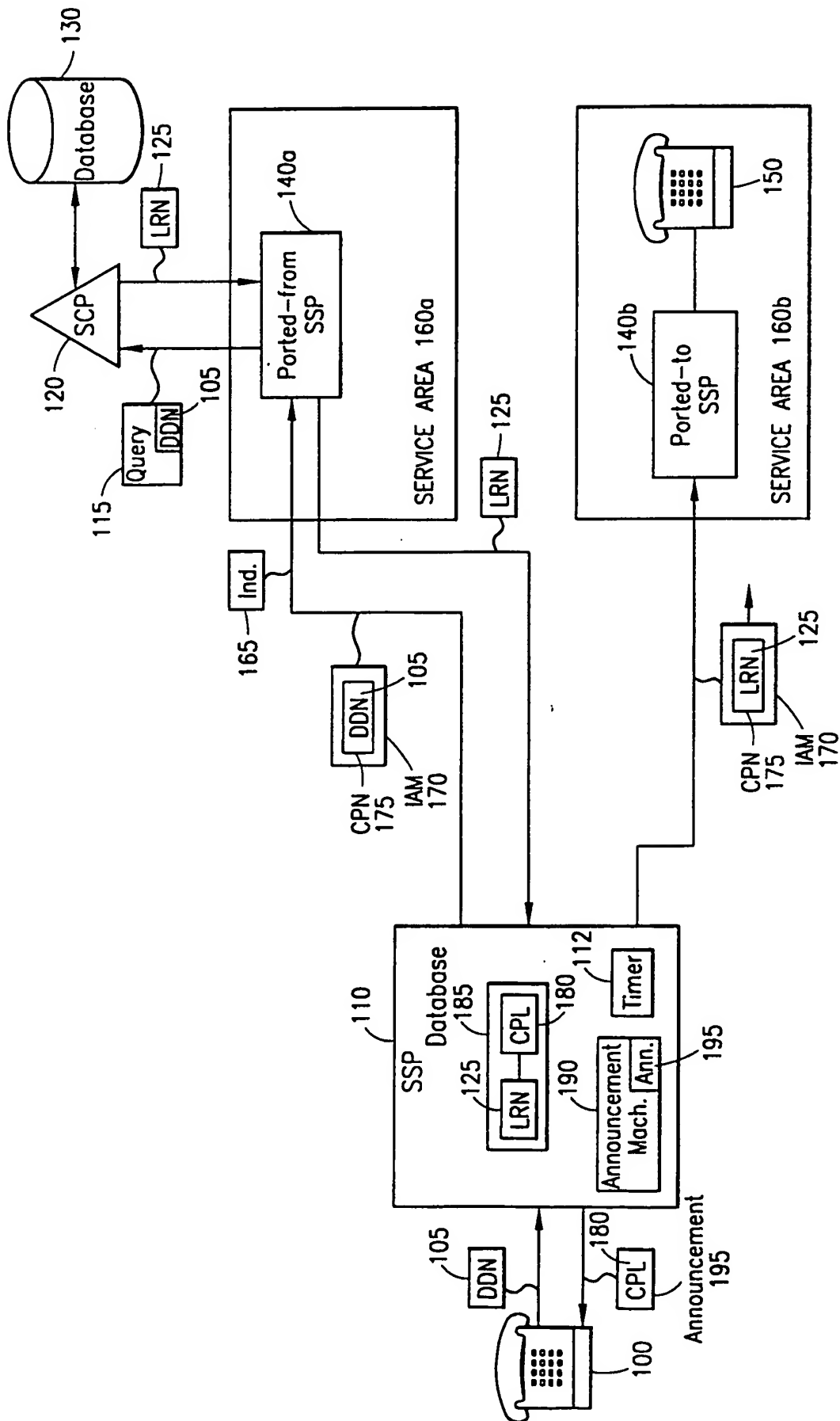


FIG. 2

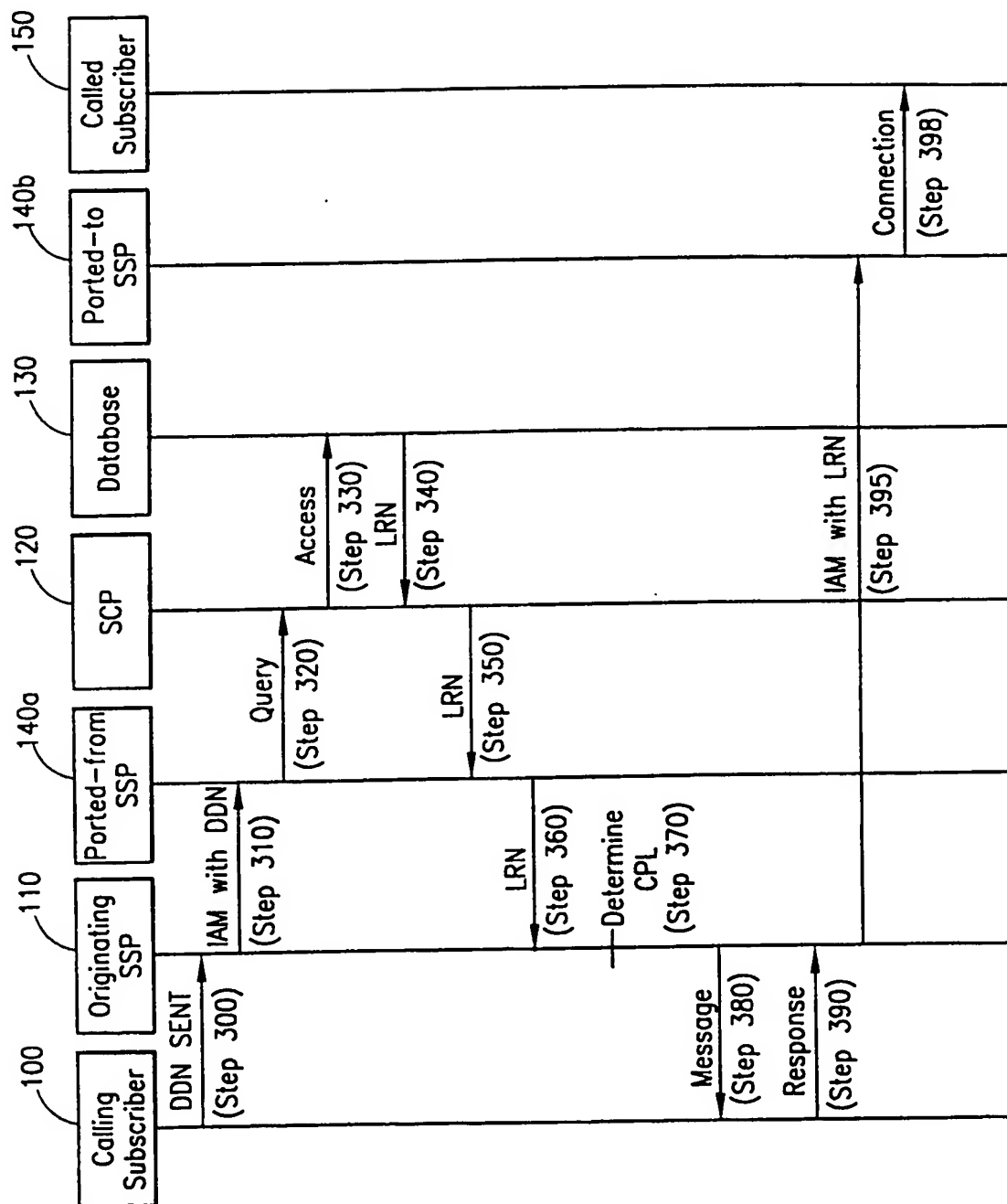


FIG. 3

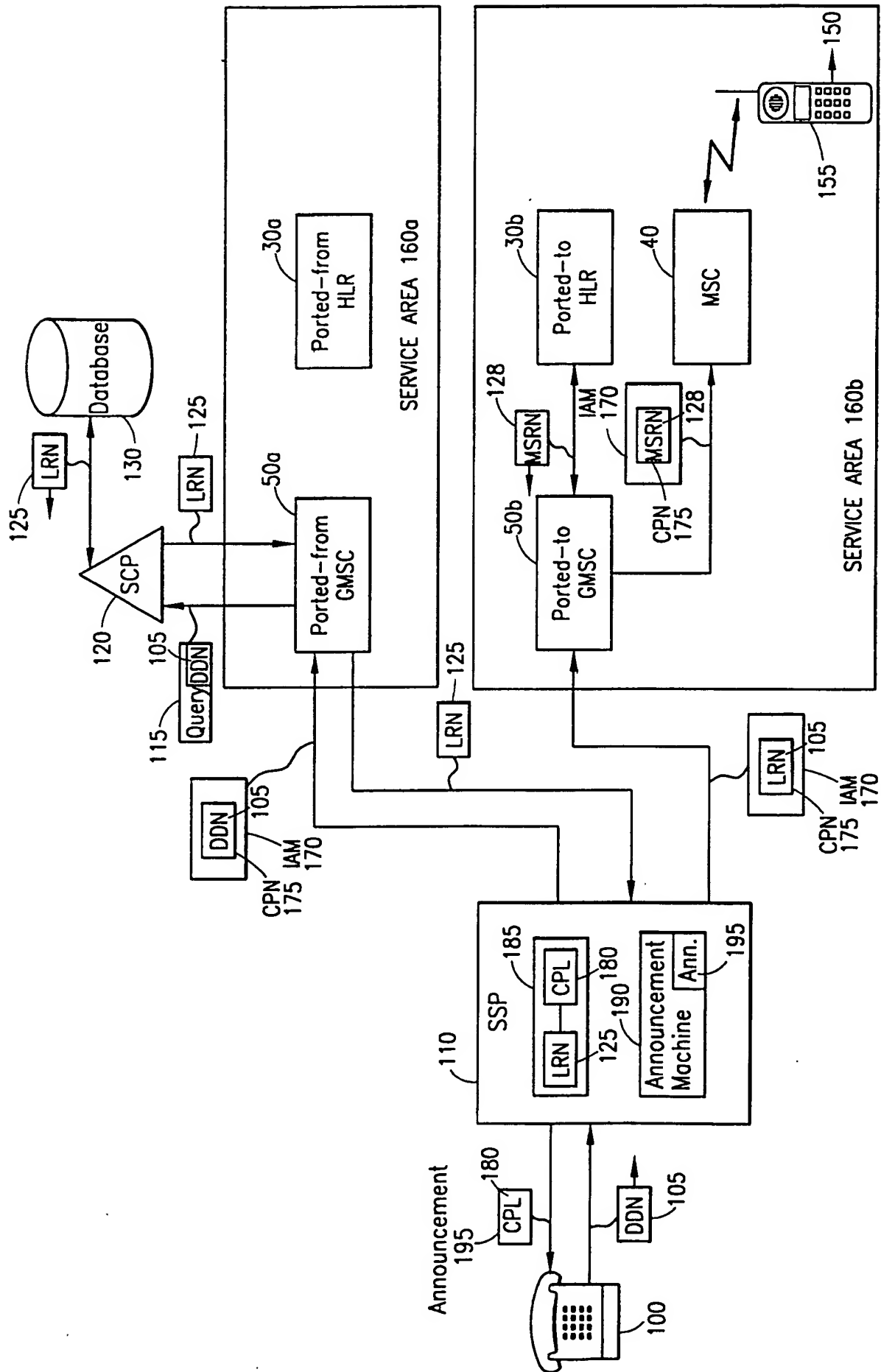


FIG. 4

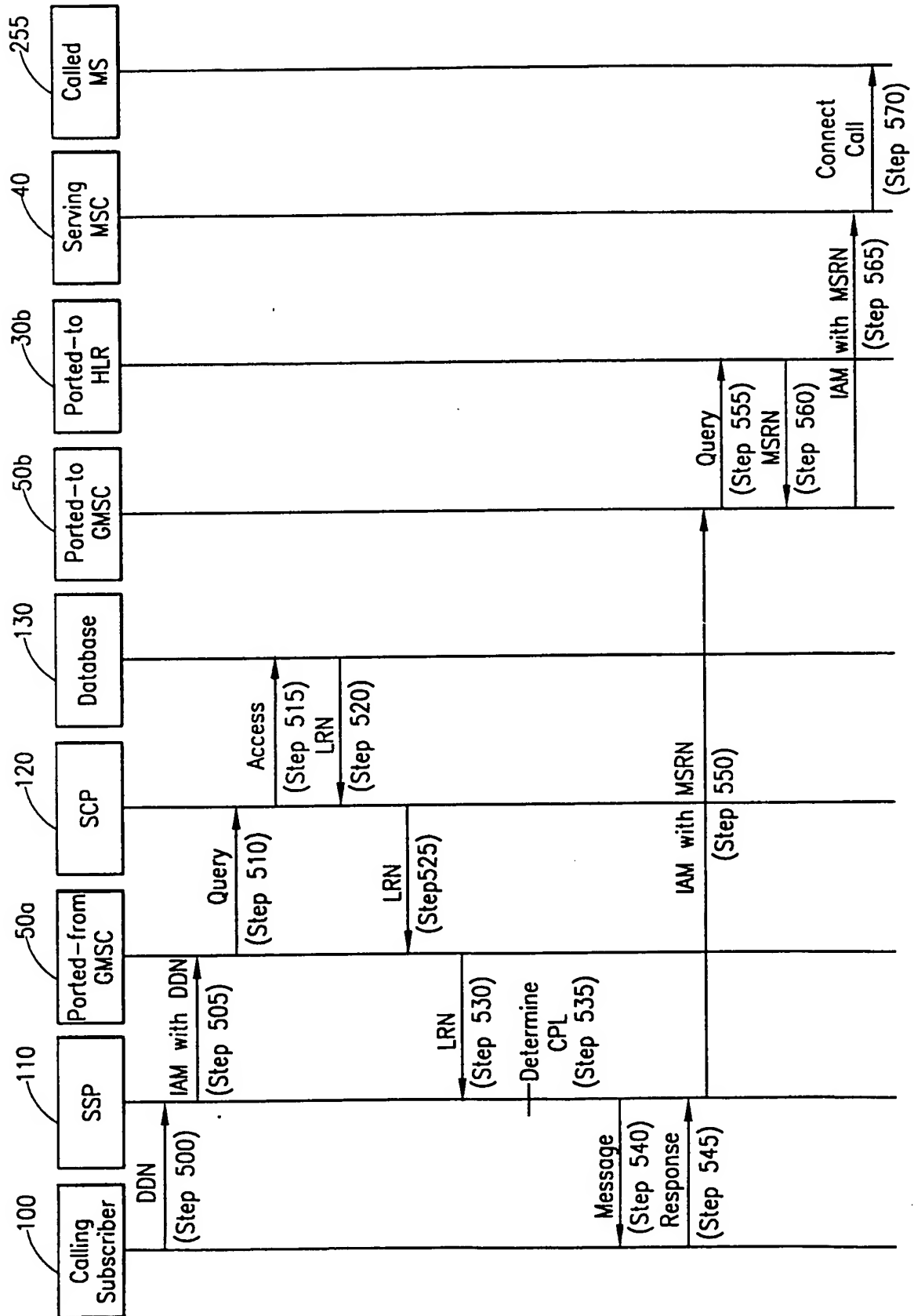


FIG. 5

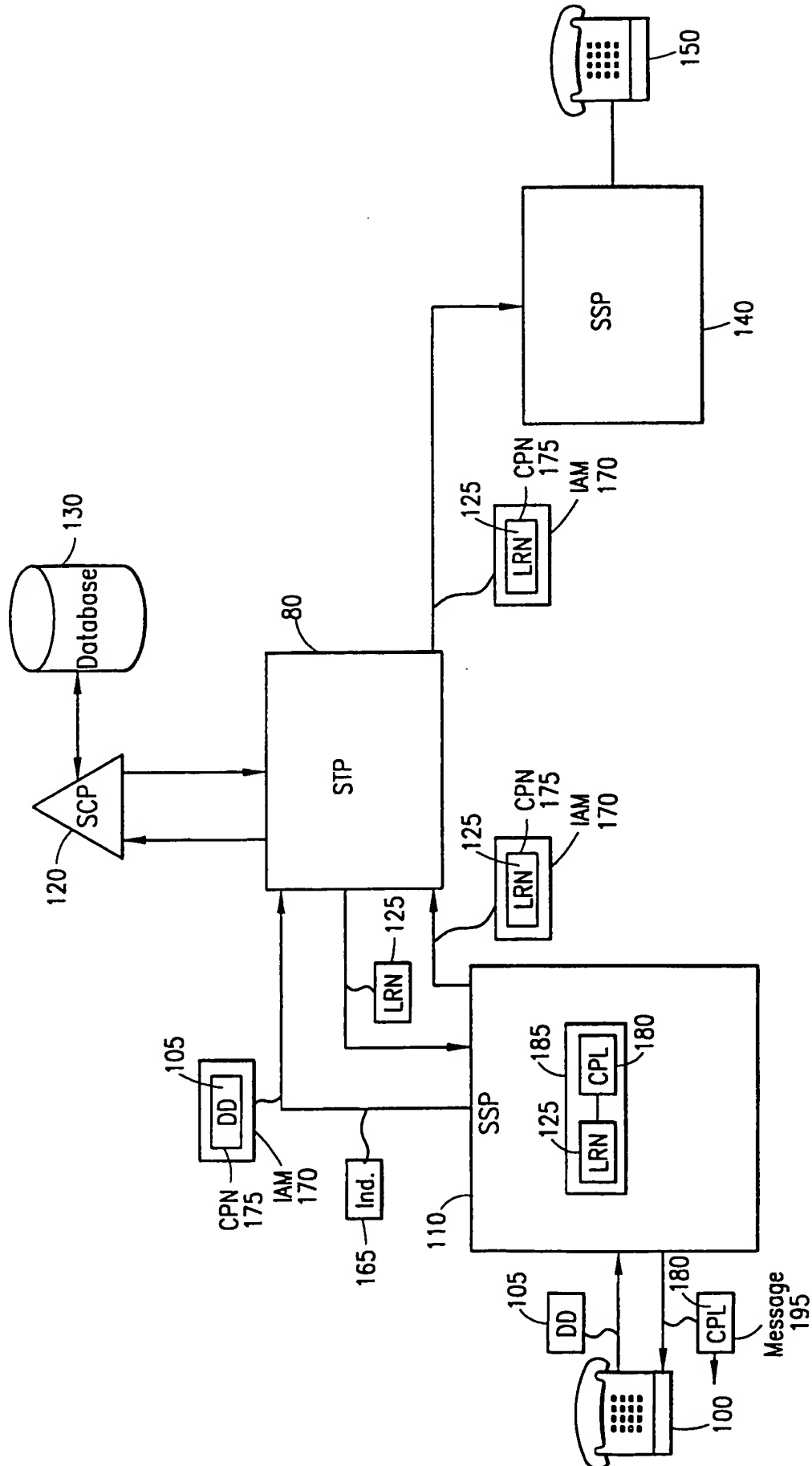


FIG. 6

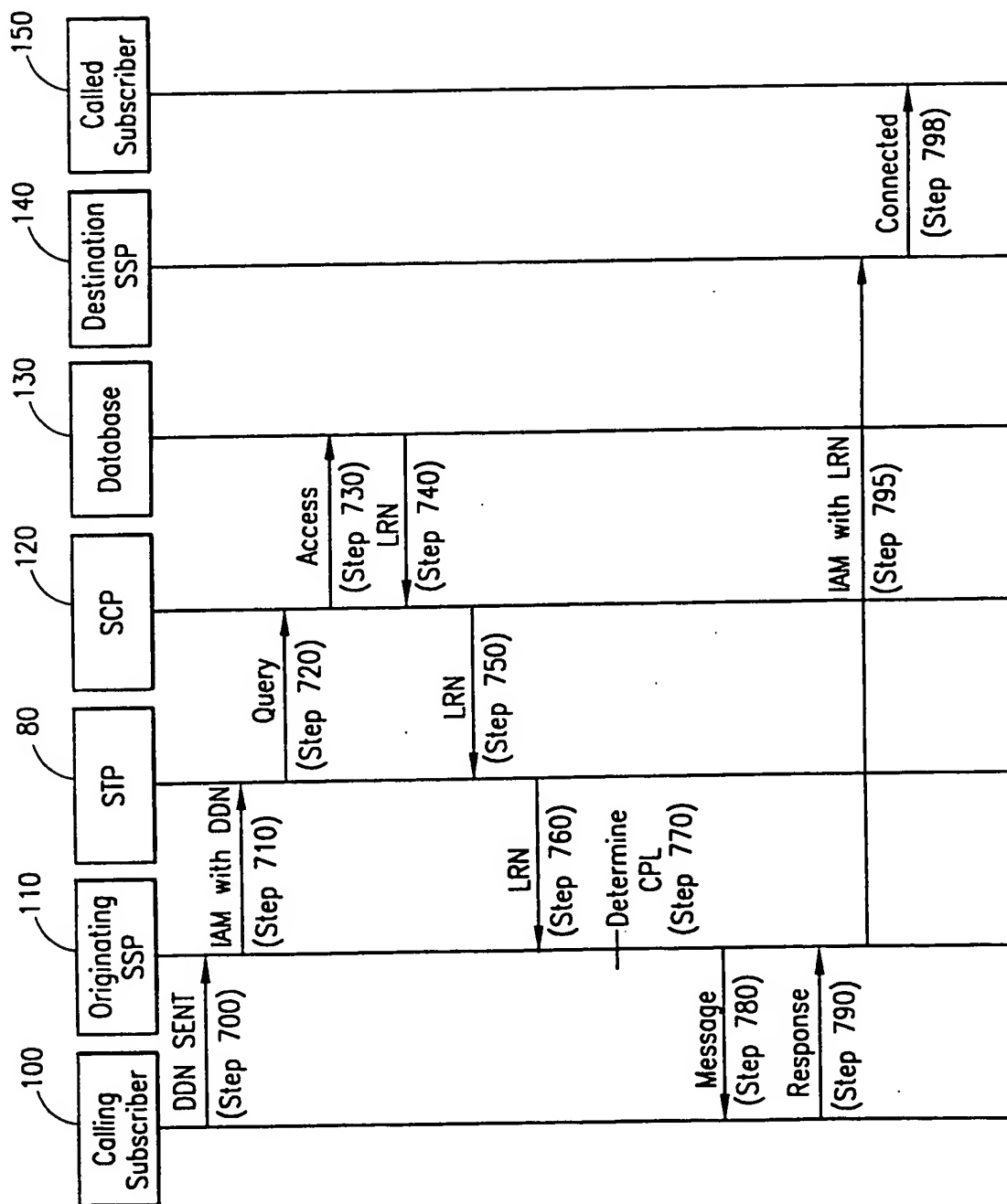


FIG. 7